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<b>(54) Title:</b> CHEWING GUM PRODUCT WITH ENCAPSULATED BICARBONATE AND FLAVORANT INGREDIENTS  <b>(57) Abstract</b>  The present invention provides a chewing gum product which has a content of one or more therapeutic ingredients for improved dental health. In one embodiment a present invention chewing gum product has a content of ingredients which include a gum base, dispersed particles of organic-encapsulated sodium bicarbonate, and a bulking sweetener. The sodium bicarbonate ingredient is a novel composition of particles having a co-encapsulated content of a flavorant ingredient.		

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CHEWING GUM PRODUCT WITH  
ENCAPSULATED BICARBONATE AND FLAVORANT INGREDIENTS

BACKGROUND OF THE INVENTION

5           Dental research has developed substantial evidence that dental plaque is the predominant etiological factor responsible for both periodontal disease and dental caries. Dental caries is the localized, progressive decay of the teeth. It  
10 results from tooth demineralization brought about by acids formed when bacteria in dental plaque ferment carbohydrate foods present in the mouth.

          Dental plaque is a deposit which accumulates on the teeth and adjacent surfaces in  
15 the oral cavity. The plaque is a product of microbial growth, primarily derived from food residues in the mouth. Mucoproteins and minerals present from the saliva and dead cells in the mouth also assist in plaque formation.

20           Plaque is removed to some extent by effective brushing of the teeth, but the less accessible and more sheltered areas of the mouth which cannot be readily reached by a toothbrush, are particularly susceptible to plaque and eventual  
25 calculus growth. Left unhindered, the plaque

increases in size and more tenaciously adheres to the teeth. The bacterial metabolism within the plaque on the tooth surface results in the production of acids, toxins and enzymes which are deleterious to the neighboring oral tissues. There is evidence pointing to plaque as being the direct cause of dental caries, due to the generation of acids within the plaque structure.

To protect a normal tooth, a thin layer of dental enamel forms a protective coating over the tooth. This coating consists mainly of calcium, phosphate, and other ions in a hydroxyapatite-like structure. The enamel contains 2-5 percent carbonate, which makes the enamel susceptible to acid dissolution.

The interaction of three factors is believed to result in dental caries: a susceptible tooth surface; microflora; and suitable substrate for the microflora. Although several acidogenic microorganisms that are present in the mouth can initiate carious lesions, *Streptococcus mutans* is believed to be the primary pathogen.

It is known that foods containing fermentable carbohydrates can promote dental caries. Tooth decay begins when the *Streptococcus mutans*, that reside principally in the plaque that adheres

to a tooth surface, metabolize the fermentable carbohydrates consumed by the host. During the metabolism of the fermentable carbohydrates by the bacteria, lactic acid and other organic acids are  
5 secreted as a by-product. These acids reduce the pH of the surrounding plaque/tooth environment.

When the pH of the plaque/tooth environment drops below a critical level of 5.5 to 5.7, hydroxyapatite (calcium phosphate hydroxide,  
10  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ ), the key component of tooth enamel, begins to dissolve. Typically, the dissolution begins below the tooth's porous surface.

With repeated acid attacks, caused by the further metabolism of fermentable carbohydrates by  
15 the bacteria, subsurface lesions expand. If the lesions expand to the point that the enamel surface breaks, a cavity is formed and the process is no longer reversible.

The natural remineralization process  
20 involves, in part, the flow of saliva over the plaque. The saliva can raise the pH of the environment. Additionally, calcium and phosphate ions in the saliva precipitate out to replace the hydroxyapatite that was dissolved by the organic  
25 acids created during the metabolism of the fermentable carbohydrates.

Typically, this remineralization process only occurs at significant levels when the pH is above the critical level. If the saliva does not sufficiently raise the pH, significant  
5 remineralization will not occur. The remineralization process may be enhanced by fluoride in the oral cavity that speeds up new crystal growth and makes a fluorapatite-like material that is precipitated on the surface of the crystals inside  
10 the carie lesion.

The most important single factor contributing to periodontal disease is the accumulation of plaque and dental calculus (e.g., salivary tartar) on the teeth. These  
15 deposits result in tissue inflammation of the surrounding gingiva, and, as the condition increases in severity, the supporting bone is also affected. These reactions lead to the destruction of the supporting structures and the subsequent mass loss  
20 of teeth which are usually free of decay.

Although brushing the teeth with a toothbrush and dentifrice is a widely recognized technique for maintaining dental health, the average American brushes only about once a day for  
25 approximately one minute. Therefore, a great need

exists for finding additional methods for improving daily oral hygiene. Chewing gum has over the years been advocated as a possible excellent adjunct for cleaning the teeth, because people find chewing of gum very pleasurable and chew gum for much longer periods of time than they brush their teeth. Chewing gum is especially advantageous for use in circumstances where toothbrushing is not possible or convenient, such as after lunch, while traveling, or while working.

In general, chewing gum comprises a neutral and tasteless masticatory chewing gum base and one or more non-masticatory active ingredients mixed into the base. As used herein, an "active ingredient" is an ingredient such as a sweetener; a flavoring agent which determines flavor and taste characteristics of the gum; a body-treating ingredient such as a medicinal drug or pharmaceutical agent which is released at a gradual rate and ingested during chewing; or a breath-freshening ingredient which treats or reduces oral malodor. In addition, the chewing gum may contain water-soluble and usually sweet non-masticatory bulking agents, a coloring agent, or a plasticizing agent which is employed to improve the texture of the gum.

Certain active chewing gum ingredients benefit from or require encapsulation in order to achieve a gradual and controlled release of the ingredients during chewing or to promote their stability in chewing gum.

U.S. 5,139,794 describes a chewing gum which has a content of an encapsulated sodium chloride ingredient. The coating on the sodium chloride particles provides a prolonged flavor-enhancing effect without imparting a salty taste.

Of background interest with respect to the present invention are publications which disclose chewing gum products containing a bicarbonate salt such as sodium bicarbonate. Prior art references include United States Patent Numbers 4,148,872; 4,150,112, 4,156,715; 4,156,716; 4,157,385; 4,159,315; 4,160,054; 4,160,820; 4,170,633; 4,269,860; 4,639,368; 4,867,989; 4,952,407; 4,997,667; 5,077,051; and the like.

There is continuing interest in the development of novel chewing gum products which provide dental health benefits during normal usage.

Accordingly, it is an object of this invention to provide a chewing gum product which can serve as a convenient adjunct for improved dental health.



It is another object of this invention to provide a chewing gum product which has a content of encapsulated therapeutic ingredient for oral hygiene which is sustain-released over a prolonged period under oral chewing conditions.

It is another object of this invention to provide a chewing gum product which counteracts bacteria-generated acids, enhances saliva flow, and exhibits plaque-inhibiting activity.

It is a further object of this invention to provide a chewing gum product with a content of encapsulated flavorant ingredient which has a prolonged taste effect under oral chewing conditions.

Other objects and advantages of the present invention shall become apparent from the accompanying description and examples.

DESCRIPTION OF THE INVENTION

One or more objects of the present invention are accomplished by the provision of a chewing gum product comprising between about  
5 15-80 weight percent of a gum base, and between about 1-30 weight percent of dispersed particles of an organic-encapsulated alkali metal bicarbonate ingredient; wherein the encapsulated particles comprise a metal bicarbonate crystallite core matrix  
10 having between about 0.1-25 weight percent of a flavorant ingredient adsorbed on the crystallite surface, based on the core matrix weight, and the core matrix of crystallite and adsorbed flavorant is surface-coated with a film-forming organic  
15 encapsulant.

In another embodiment this invention provides a chewing gum product comprising  
(1) between about 15-80 weight percent of a gum base; (2) between about 1-30 weight percent of  
20 dispersed particles of an organic-encapsulated alkali metal bicarbonate ingredient, wherein the encapsulated particles comprise an alkali metal bicarbonate crystallite core matrix having between about 0.1-25 weight percent of a flavorant  
25 ingredient adsorbed on the crystallite surface, based on the core matrix weight, and the core matrix

of crystallite and adsorbed flavorant is surface-coated with a film-forming organic encapsulant; (3) between about 0-25 weight percent of alkali metal bicarbonate powder ingredient; (4) between  
5 about 5-70 weight percent of a water-soluble bulking ingredient; (5) between about 0-0.2 weight percent of a colorant ingredient; (6) between about 0-20 weight percent of an abrasive ingredient; (7) between about 0-3 weight percent of a surfactant  
10 ingredient; (8) between about 0-3 weight percent of a fluoridating ingredient; and (9) between about 1-15 weight percent of glycerin or lecithin or a mixture thereof.

A present invention chewing gum may be any  
15 variety of different chewing gum types including low and high moisture, sugar or sugarless, wax-containing or wax-free, low calorie, and the like, and can contain other oral hygiene agents.

A chewing gum product generally consists  
20 of a water-insoluble gum base, a water-soluble portion, and flavors. The water-soluble portion dissipates over a period of time, and the gum base portion is retained during mastication.

A conventional chewing gum base usually  
25 contains an elastomer, an elastomer solvent, and various other ingredients such as fillers, softeners, plasticizers and emulsifiers. Gum base

raw materials are described in United States Patent Numbers 2,366,589; 3,821,417; 3,984,574; 4,041,179; 4,170,633; 4,400,372; 4,590,075; and 5,378,131; incorporated by reference. The history and  
5 development of chewing gum products is elaborated in "Chewing Gum" by A. H. Suck, (Haarmann & Reimer, Second Edition), incorporated by reference.

Chewing gum base elastomers for stick gum and dragees include chicle, jelutong, balata, crown  
10 gum, guttapercha, sorva, butadiene-styrene copolymer, polyisobutylene, isobutylene-isoprene copolymer, polyethylene, and the like, and mixtures thereof.

Chewing gum base elastomer solvents  
15 include pentaerythritol ester of wood rosin, glycerol ester of polymerized rosin, partially hydrogenated methyl ester of rosin, and the like.

Chewing gum base waxes include natural wax, polyethylene wax, paraffin wax, beeswax,  
20 microcrystalline wax, and the like.

Chewing gum base compositions for stick gum and dragees are commercially available under tradenames such as Paloja T, Firm Paloja T and Nova T (L. A. Dreyfus Corp.). Bubble gum bases are  
25 available as Paloja Bubble T, Ladco Bubble T and Grande Bubble T (L. A. Dreyfus Corp).

An essential ingredient of a present invention chewing gum composition is between about 1-30 weight percent of a dispersed particle phase of an organic-encapsulated alkali metal bicarbonate ingredient, in which the core matrix comprises bicarbonate crystallite and flavorant constituents.

The alkali metal bicarbonate crystallite core matrix of the encapsulated particles is sodium bicarbonate or potassium bicarbonate or a mixture thereof. Optionally, the alkali metal bicarbonate core matrix of the encapsulated particles can have a content between about 0.1-20 weight percent of alkali metal carbonate, based on the weight of alkali metal bicarbonate core matrix content. The alkali metal carbonate can be a sodium or potassium salt or a mixture thereof.

The average particle size of the encapsulated alkali metal bicarbonate/flavorant ingredient can range between about 20-400 microns. The organic encapsulant of the coated particles typically comprises between about 5-60 weight percent of the encapsulated alkali metal bicarbonate/flavorant particles. The thickness of the encapsulant coating on the surface of the bicarbonate/flavorant core matrix typically will vary in the range between about 0.1-20 microns.

The flavorant ingredient in the core matrix of the encapsulated particles can be in solid or liquid form, and can be of natural or synthetic origin. Chewing gum flavorants are described in  
5 United States Patent Numbers 3,826,847; 5,128,155; and 5,266,335; incorporated by reference. Suitable flavorants include menthol, peppermint oil, spearmint oil, wintergreen oil, cinnamon oil, anise, and the like.

10 A liquid or powder flavorant ingredient can be adsorbed on the bicarbonate salt crystallite surfaces by adding a calculated quantity of fragrance ingredient to a bulk bicarbonate salt powder, and then mixing the combined ingredients  
15 until the flavorant ingredient is homogeneously distributed and adsorbed on the crystallite surfaces.

As an alternative method, the fragrance ingredient is dissolved in a solvent such as ethanol  
20 or acetone, and the solution is applied to the bicarbonate salt powder. Evaporation of the solvent provides the desired bicarbonate salt powder having a content of liquid or solid fragrance homogeneously distributed on the crystallite surfaces.

25 The application of the organic coating to the flavorant-adsorbed crystallite surfaces of the bicarbonate powder is accomplished by conventional

means such as pan coating, fluidized coating, and the like. The encapsulant usually is dissolved in a suitable solvent such as water, methanol, ethanol, acetone, tetrahydrofuran, ethyl acetate, dimethylformamide, and the like, as appropriate for a selected organic species. An encapsulant also can be applied in the form of an emulsion or suspension. After the coating medium is applied to the bicarbonate salt crystallites, the solvent medium is removed by evaporation, thereby forming a continuous film coating which encapsulates the discrete fine grain crystallites, together with the flavorant ingredient adsorbed on the crystallite surfaces.

In a preferred coating procedure, bicarbonate/flavorant powder is dispersed in an aqueous medium which contains a film-forming coating ingredient. The aqueous dispersion is atomized and sprayed into heated air to remove the aqueous phase, and to provide a free-flowing encapsulated bicarbonate/flavorant powder product.

The organic encapsulant of the coated particles is selected from hydrophilic and hydrophobic (water-insoluble) film-forming agents, and mixtures thereof, such as hydrocolloids and polysaccharides.

The term "hydrophilic" as employed herein refers to an encapsulant film-forming agent which has a water-solubility of at least about two grams per one hundred grams of water at 25°C.

5           The organic encapsulant can consist of 100% hydrophilic encapsulant, or 100% water-insoluble encapsulant, or any mixture thereof. The rate of alkali metal bicarbonate and flavorant release during mastication of a chewing gum product  
10 is directly related to the hydrophilicity of the encapsulant on the coated particles. A hydrophilic encapsulant coating will sustain-release the core alkali metal bicarbonate and flavorant content over a period of about 20 minutes. A water-insoluble  
15 encapsulant coating will sustain-release the alkali metal bicarbonate and flavorant over a period of about 35 minutes. An organic encapsulant can comprise a hydrophilic polymer having a content between about 5-80 weight percent of a water-  
20 insoluble polymer.

Suitable hydrophilic encapsulants for coating the alkali metal bicarbonate/flavorant core matrix include gum arabic, gum karaya, gum tragacanth, guar gum, locust bean gum, xanthan gum,  
25 carrageenan, alginate salt, casein, dextran, pectin, agar, sorbitol, 2-hydroxyethyl starch, 2-aminoethyl



starch, maltodextrin, amyloextrin, 2-hydroxyethyl cellulose, methyl cellulose, carboxymethyl cellulose salt, cellulose sulfate salt, polyvinylpyrrolidone, polyethylene oxide, polyvinyl alcohol/acetate, and  
5 the like. Polyvinyl acetate is illustrative of a water-insoluble polymer which can be included as an additional coating component to moderate the hydrophilicity of a hydrophilic polymer coating.

Suitable water-insoluble encapsulants  
10 include polyvinyl acetate, polyacrylamide, polyvinyl chloride, polystyrene, polyethylene, polyurethane, polymethacrylate, paraffin wax, carnauba wax, beeswax, stearyl alcohol, zein, shellac, edible fat, and the like. Encapsulants utilized in chewing gum  
15 products are disclosed in U.S. 4,673,577, U.S. 5,139,794 and U.S. 4,933,190, incorporated by reference.

In another embodiment a present invention chewing gum product has a content between about  
20 0.5-25 weight percent of particulate alkali metal bicarbonate ingredient which is not encapsulated. The unencapsulated alkali metal bicarbonate can contain between about 0.1-20 weight percent of alkali metal carbonate, based on the weight of  
25 unencapsulated alkali metal bicarbonate.

The unencapsulated alkali metal bicarbonate ingredient typically can have an average particle size between about 10-400 microns. In a preferred embodiment, the alkali metal bicarbonate  
5 is in micronized form, and has an average particle size between about 0.5-20 microns.

During mastication of a chewing gum product containing both encapsulated and unencapsulated alkali metal bicarbonate ingredients,  
10 the product provides both immediate and long lasting oral hygiene benefits. There is a clean taste and breath refreshment, and a prolonged deodorizing effect on mouth odor.

In another embodiment a present invention  
15 chewing gum product has a content between about 5-70 weight percent of a water-soluble bulking ingredient.

The term "water-soluble" as employed herein refers to a chewing gum ingredient which has  
20 a solubility of at least about five grams per one hundred grams of water at 25°C.

The water-soluble bulking ingredient in a chewing gum product typically includes bulk sweeteners, high-potency sweeteners, flavorants,  
25 softeners, emulsifiers, colorants, fillers, antioxidants, and other constituents which contribute desirable attributes.

Between about 0.1-15 weight percent of a softener ingredient can be added to enhance the chewability and mouth feel of the chewing gum. The softener ingredient can comprise glycerin or  
5 lecithin or a mixture thereof, which additionally functions as a humectant.

The bulking ingredient can comprise between about 5-70 weight percent of a bulking sweetener. Bulking sweeteners can consist of sugar  
10 and/or sugarless constituents. Sugar sweeteners are illustrated by saccharides such as sucrose, glucose, maltose, dextrin, dried invert sugar, fructose, levulose, galactose, corn syrup solids, and the like.

15 Sugarless sweeteners are illustrated by polyhydric alcohols such as sorbitol, mannitol, xylitol, hydrogenated starch hydrolysates, maltitol, and the like.

Between about 0.025-2 weight percent of a  
20 high intensity sweetener ingredient can be utilized alone or in combination with a bulk sweetener. High intensity sweeteners are illustrated by aspartame, saccharin, cyclamate, thaumatin, dihydrochalcones, acesulfame K compounds, and the like. Long lasting  
25 sweeteners can be achieved by encapsulating a portion or all of a high intensity sweetener ingredient. A higher content of high intensity

sweetener can be employed when it is encapsulated. Encapsulants and coating techniques can be used which are similar to those described herein for an encapsulated alkali metal bicarbonate ingredient.

5           A chewing gum product optionally can contain between about 0.5-10 weight percent of additional flavorant ingredient, which is the same or different than the encapsulated flavorant ingredient.

10           A present invention chewing gum product also can contain between about 0.001-0.2 weight percent of a colorant ingredient, such as FD&C-type dyes and lakes. The colorant can be in the form of particles which give the gum matrix a speckled  
15 appearance. The speckled effect also can be incorporated in a surface coating, such as the coating on dragee gum products. Speckled gum products are described in U.S. 4,744,991, incorporated by reference.

20           A chewing gum product additionally can contain between about 0.01-3 weight percent of an antioxidant ingredient such as butylated hydroxytoluene, butylated hydroxyanisole, propyl gallate, and the like.

25           Between about 1-20 weight percent of an abrasive ingredient also can be included in a present invention chewing gum product to provide a dentifrice cleaning action, in addition to the

abrasive activity of the alkali metal bicarbonate ingredient. Suitable abrasives include a powder form of phosphate and silica compounds such as calcium phosphate, silica xerogel, and the like.

- 5 Other types of suitable abrasives are described in U.S. 4,170,633 and U.S. 4,891,211, incorporated by reference.

The compatibility of the ingredients in a chewing gum product, and the enhancement of flavor,  
10 can be accomplished by the inclusion of between about 0.001-3 weight percent of a surfactant ingredient in the chewing gum product.

Suitable anionic surfactants include alkali metal and ammonium C<sub>8</sub>-C<sub>30</sub> aliphatic-containing  
15 carboxylate, sulfonate, sulfate and phosphate salts, such as sodium dioctyl sulfosuccinate, sodium lauryl sulfate, sodium dodecylbenzenesulfonate, ammonium lignosulfonate, and the like.

Suitable nonionic surfactants include  
20 condensation products of alkylene oxide with fatty alcohols, amines and alkylphenols, such as ethoxylated sorbitan monostearate, ethoxylated glycerol monostearate, and the like.

Suitable cationic surfactants include  
25 cetyltrimethylammonium bromide, cetylpyridinium chloride, benzyldimethylstearyl ammonium chloride,

and the like. This type of surfactant additionally imparts antibacterial activity to a chewing gum product.

Other surfactants which are suitable for inclusion in a chewing gum product are described in U.S. 3,930,026, incorporated by reference.

A present invention chewing gum product also can contain between about 0.05-3 weight percent of a fluoridating ingredient for the prevention of dental caries. Fluoridating agents are illustrated by alkali metal fluoride, ammonium fluoride, stannous fluoride, stannous chlorofluoride, potassium stannous fluoride, alkali metal monofluorophosphate, ammonium monofluorophosphate, and the like.

In another embodiment this invention contemplates a chewing gum product comprising between about 15-80 weight percent of a gum base, between about 5-70 weight percent of a water-soluble bulking ingredient, and between about 1-30 weight percent of dispersed particles of an organic-encapsulated alkali metal bicarbonate ingredient; wherein the encapsulated particles comprise an alkali metal bicarbonate crystallite core matrix having a surface-coating of an encapsulant

comprising a blend of a film-forming organic ingredient and between about 0.1-25 weight percent of a flavorant ingredient, based on the encapsulant weight.

5           The application of the encapsulant blend of film-forming organic ingredient and flavorant to the bicarbonate crystallite surface can be accomplished by conventional means as previously described. The encapsulant constituents usually are  
10 dissolved in a solvent such as ethanol, and the solution is applied to the bicarbonate powder. The solvent then is removed by evaporation, thereby forming a continuous film of encapsulant blend on the discrete bicarbonate crystallites.

15           In another embodiment this invention provides an encapsulated bicarbonate powder composition comprising particles which are comprised of an alkali metal bicarbonate crystallite core matrix having between about 0.1-25 weight percent of  
20 a flavorant ingredient adsorbed on the crystallite surface, based on the core matrix weight, and the core matrix of crystallite and adsorbed flavorant is surface-coated with an organic encapsulant.

          In another embodiment this invention  
25 provides an encapsulated bicarbonate powder composition comprising particles which are comprised of an alkali metal bicarbonate crystallite core

matrix having a surface-coating of an encapsulant comprising a blend of a film-forming organic ingredient and between about 0.1-25 weight percent of a flavorant ingredient, based on the encapsulant weight.

5 A present invention chewing gum product can be produced in accordance with conventional manufacturing processes, such as those described in U.S. 4,329,369, and as demonstrated in the following examples.

10 A present invention chewing gum product provides a novel combination of properties which function as a convenient adjunct to other oral hygiene vehicles such as toothpastes and mouthwashes.

In a further embodiment this invention provides a method of oral hygiene which comprises orally masticating a present invention chewing gum product in accordance with a regimen which satisfies personal need and convenience.

20 The encapsulated alkali metal bicarbonate/flavorant ingredients of a present invention chewing gum product are sustain-released over a prolonged period under gum mastication conditions.



A present invention chewing gum product provides dental cleaning action, and counteracts bacteria-generated acids, enhances saliva flow, and exhibits plaque-inhibiting and tartar-control activities.

The alkali metal bicarbonate ingredient of a present invention chewing gum product contributes oral care benefits such as dental cleaning and whitening, and a prolonged period of mouth odor reduction. Other derived advantages are perceptions of breath refreshment and a pleasant mouthfeel during gum chewing.

The following examples are further illustrative of the present invention. The components and specific ingredients are presented as being typical, and various modifications can be derived in view of the foregoing disclosure within the scope of the invention.

EXAMPLE I

This Example illustrates the particle size distribution of sodium bicarbonate before and after air-jet milling.

5           Commercial grade sodium bicarbonate (3DF, Church & Dwight) is processed by air-jet milling (Particle Size Technology, Inc.), and the particle size distribution of milled samples is determined in comparison with unmilled samples by  
10 means of a Microtrac laser-scattering particle size analyzer.

The 3DF sodium bicarbonate has an average particle size of 31.4 microns, and the micronized 3DF sodium bicarbonate has an average particle size  
15 of 9.8 microns.

The middle 80% of particle size distribution is between 15.4 and 55.8 microns for the 3DF sodium bicarbonate, and between 4.3 and 21.5 microns for the micronized form.

EXAMPLE II

This Example illustrates a fluidized bed procedure for encapsulating particulate bicarbonate and flavorant compounds with an organic coating in accordance with the present invention.

A fluidized bed vessel is utilized which is equipped with a Wurster air-suspension coater system (WARF) as described in U.S. 4,568,559 and U.S. 4,877,621.

A coating solution is prepared by dissolving polyethylene glycol (45 g, Poly-G 2000, Olin Corp.), and propylene glycol butyl ether (10 g, PPG 14, Americol) in ethanol (500 g)/water (75 g).

Sodium bicarbonate is utilized as the core matrix crystallites. The sodium bicarbonate (Particle Size Technology, Inc.) has an average particle size and particle size distribution having correspondence with an Example I type of micronized powder.

The sodium bicarbonate powder is blended with 12 weight percent of spearmint oil. The blended powder is charged into the coating chamber of the coater system.

Compressed air is introduced into the coating chamber, and the organic coating solution is sprayed on the air-suspended bicarbonate/flavorant

core matrix crystallites, until the coating weight is about 30% of the total dry weight of the coated particles.

The procedure is repeated, except that  
5 hydroxypropylmethylcellulose (Methocel 60 HG, Dow Chemical Co.) is employed as the film-forming coating medium.

The procedure is repeated, except that  
maltodextrin (Lodex 10; Durkee Foods) or  
10 amyloextrin is employed as the coating medium, and 0.5 g of a surfactant is included in the solution (polyoxyethylenesorbitan monolaurate; Tween 20; ICI Americas, Inc.).

The coated particles consist of a  
15 continuous film coating on an inner core of between about 2-10 crystallites of flavorant-adsorbed sodium bicarbonate. The coated particles have an average particle size of about 35 microns.

The procedure is repeated except that a  
20 polyvinyl acetate (M.W. 40,000) is employed as the polymeric medium for coating the sodium bicarbonate crystallites.

EXAMPLE III

This Example illustrates a fluidized bed procedure for encapsulating a particulate bicarbonate compound with a polymer/flavorant coating in accordance with the present invention.

A fluidized bed vessel is utilized which is equipped with a Wurster air-suspension coater system (WARF) as described in U.S. 4,568,559 and U.S. 4,877,621.

A coating solution is prepared by dissolving polyethylene glycol (60 g, Poly-G 2000, Olin Corp.), and cinnamon oil (8 g) in ethanol.

Sodium bicarbonate is utilized as the core matrix particles. The sodium bicarbonate has an average particle size and particle size distribution having correspondence with an Example I type of commercial 3DF powder.

The sodium bicarbonate powder is charged into the coating chamber of the coater system.

Compressed air is introduced into the coating chamber, and the polymer/flavorant coating solution is sprayed on the air-suspended bicarbonate core matrix crystallites, until the coating weight is about 20% of the total dry weight of the coated particles.

The procedure is repeated, except that hydroxypropylmethylcellulose (Methocel 60 HG, Dow Chemical Co.) is employed as the film-forming coating medium.

- 5           The procedure is repeated, except that maltodextrin (Lodex 10; Durkee Foods) or amyloextrin is employed as the coating medium, and 0.5 g of a surfactant is included in the solution (polyoxyethylenesorbitan monolaurate; Tween 20; 10 ICI Americas, Inc.).

The coated particles consist of a continuous film coating on an inner core of sodium bicarbonate crystallite. The coated particles have an average particle size of about 45 microns.

- 15           The procedure is repeated except that a polyvinyl acetate (M.W. 40,000) is employed as the polymeric medium for coating the sodium bicarbonate particles.

- 20           In a separate procedure, initially coated particles are re-coated with the polyethylene glycol in ethanol solution, except that no flavorant is included in the second coating solution. Each of the first and second coatings on the particles is about 10 weight percent of the total dry weight of 25 the coated particles.

EXAMPLE IV

This Example illustrates the preparation of a chewing gum product in accordance with the present invention.

- 5           An invention chewing gum product is prepared by processing the following ingredients:

	<u>Wt. %</u>
Cafosa Luxor 225-01 gum base <sup>(1)</sup>	23.92
sorbitol liquid (70% solution)	2.39
10 sorbitol powder	31.48
mannitol powder	14.35
maltitol powder	9.57
sodium bicarbonate, micronized <sup>(2)</sup>	4.78
sodium bicarbonate, encapsulated <sup>(3)</sup>	4.78
15 spearmint oil	1.44
glycerin (96%)	7.18
sodium saccharin	0.10
Blue #2 Lake	0.006

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20   <sup>(1)</sup> Cafosa Co.

<sup>(2)</sup> Average particle size of 12 microns (Example I).

<sup>(3)</sup> Polyvinyl acetate coating on a sodium bicarbonate/spearmint oil core matrix (Example II).

The sorbitol, mannitol, maltitol, micronized sodium bicarbonate and encapsulated sodium bicarbonate powders are blended. About one third of the blend is added to the preheated gum  
5 base (122°F) in a mixer unit, and the medium is mixed for about 3 minutes.

The liquid sorbitol and glycerin are combined to form a solution. About one half of the solution is added slowly to the mixer contents, and  
10 the medium is mixed for about 3 minutes.

The remaining dry blend and liquid solution portions are added with continuous mixing. The sodium saccharin and colorant are added with mixing, followed by the addition of the spearmint  
15 oil flavorant. The ingredient mass is mixed until homogeneous. The resultant chewing gum formulation is rolled, sheeted, sized and packaged as a stick chewing gum product.



WHAT IS CLAIMED IS:

1. A chewing gum product comprising  
between about 15-80 weight percent of a gum base,  
between about 5-70 weight percent of a water-soluble  
5 bulking ingredient, and between about 1-30 weight  
percent of dispersed particles of an organic-  
encapsulated alkali metal bicarbonate ingredient;  
wherein the encapsulated particles comprise a metal  
bicarbonate crystallite core matrix having between  
10 about 0.1-25 weight percent of a flavorant  
ingredient adsorbed on the crystallite surface,  
based on the core matrix weight, and the core matrix  
of crystallite and adsorbed flavorant is surface-  
coated with a film-forming organic encapsulant.
- 15 2. A chewing gum product in accordance  
with claim 1 wherein the alkali metal bicarbonate  
ingredient has a content between about 0.1-20 weight  
percent of alkali metal carbonate, based on the  
weight of alkali metal bicarbonate.
- 20 3. A chewing gum product in accordance  
with claim 1 which additionally contains between  
about 0.001-0.2 weight percent of a colorant  
ingredient.

4. A chewing gum product in accordance with claim 1 which additionally contains between about 0.01-3 weight percent of an antioxidant ingredients.

5           5. A chewing gum product in accordance with claim 1 which additionally contains between about 0.5-25 weight percent of an alkali metal bicarbonate powder ingredient.

10           6. A chewing gum product in accordance with claim 1 which additionally contains between about 0.5-25 weight percent of an alkali metal bicarbonate powder ingredient, and between about 0.1-20 weight percent of alkali metal carbonate, based on the weight of additional alkali metal  
15 bicarbonate powder ingredient.

7. A chewing gum product in accordance with claim 1 which additionally contains between about 1-20 weight percent of an abrasive ingredient.

20           8. A chewing gum product in accordance with claim 1 which additionally contains between about 0.001-3 weight percent of a surfactant ingredient.

9. A chewing gum product in accordance with claim 1 which additionally contains between about 0.05-3 weight percent of a fluoridating ingredient.

5           10. A chewing gum product in accordance with claim 1 which additionally contains between about 0.1-15 weight percent of glycerin or lecithin or a mixture thereof.

10           11. A chewing gum product in accordance with claim 1 wherein the bulking ingredient is a sweetener selected from the group consisting of sucrose, glucose, multitol, xylitol, sorbitol and mannitol and mixtures thereof.

15           12. A chewing gum product in accordance with claim 1 which additionally contains between about 0.5-25 weight percent of sodium bicarbonate or potassium bicarbonate having an average particle size between about 0.5-20 microns.

20           13. A chewing gum product in accordance with claim 1 which additionally contains between about 1-20 weight percent of an abrasive ingredient selected from the group consisting of calcium phosphate and silica compounds and mixtures thereof.

14. A chewing gum product in accordance with claim 1 which additionally contains between about 0.001-3 weight percent of a surfactant ingredient selected from the group consisting of  
5 alkali metal and ammonium C<sub>8</sub>-C<sub>22</sub> aliphatic-containing carboxylate, sulfonate, sulfate and phosphate salts and mixtures thereof.

15. A chewing gum product in accordance with claim 1 which additionally contains between  
10 about 0.05-3 weight percent of a fluoridating ingredient selected from the group consisting of alkali metal fluoride, ammonium fluoride, stannous fluoride, stannous chlorofluoride, potassium  
stannous fluoride, alkali metal monofluorophosphate,  
15 and ammonium monofluorophosphate and mixtures thereof.

16. A chewing gum product in accordance with claim 1 which additionally contains between about 0.025-2 weight percent of a high intensity  
20 sweetener selected from the group consisting of aspartame, saccharin, cyclamate, thaumatin, dihydrochalcones and acesulfame K compounds and mixtures thereof.

17. A chewing gum product in accordance with claim 1 which additionally contains between about 0.01-3 weight percent of an antioxidant ingredient selected from the group consisting of  
5 butylated hydroxytoluene, butylated hydroxyanisole and propyl gallate and mixtures thereof.

18. A chewing gum product in accordance with claim 1 wherein the organic encapsulant comprises between about 5-60 weight percent of the  
10 surface-coated bicarbonate particle dry weight.

19. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is a hydrophilic polymer or water-insoluble polymer or a  
15 mixture thereof.

20. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is a hydrophilic polymer having a content between about  
20 5-80 weight percent of a water-insoluble polymer, based on the coating weight.

21. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is a polysaccharide.

5           22. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is a hydrocolloid.

10           23. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is a starch.

15           24. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is food grade shellac.

            25. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is polyvinyl acetate.

20           26. A chewing gum product in accordance with claim 1 wherein the organic encapsulant on the surface-coated bicarbonate particles is selected from water-insoluble fats and waxes.

27. A chewing gum product in accordance with claim 1 wherein the encapsulated flavorant is an ingredient selected from the group consisting of menthol, peppermint oil, spearmint oil, wintergreen oil, cinnamon oil and anise and mixtures thereof.

28. A chewing gum product comprising  
(1) between about 15-80 weight percent of a gum base; (2) between about 1-30 weight percent of dispersed particles of an organic-encapsulated alkali metal bicarbonate ingredient, wherein the encapsulated particles comprise an alkali metal bicarbonate crystallite core matrix having between about 0.1-25 weight percent of a flavorant ingredient adsorbed on the crystallite surface, based on the core matrix weight, and the core matrix of crystallite and adsorbed flavorant is surface-coated with a film-forming organic encapsulant;  
(3) between about 0-25 weight percent of alkali metal bicarbonate powder ingredient;  
(4) between about 5-70 weight percent of a water-soluble bulking ingredient; (5) between about 0-0.2 weight percent of a colorant ingredient;  
(6) between about 0-20 weight percent of an abrasive ingredient; (7) between about 0-3 weight percent of a surfactant ingredient; (8) between about 0-3 weight percent of a fluoridating ingredient; and  
(9) between about 0-15 weight percent of glycerin or lecithin or a mixture thereof.

29. A chewing gum product in accordance with claim 28 wherein the organic encapsulant comprises between about 5-60 weight percent of the surface-coated bicarbonate particle dry weight.

5           30. A chewing gum product in accordance with claim 28 wherein the organic encapsulant on the surface-coated bicarbonate particles is a hydrophilic polymer or water-insoluble polymer or a mixture thereof.

10           31. A chewing gum product in accordance with claim 28 wherein the encapsulated flavorant is an ingredient selected from the group consisting of menthol, peppermint oil, spearmint oil, wintergreen oil, cinnamon oil and anise and mixtures thereof.

15           32. A chewing gum product in accordance with claim 28 wherein the bulking ingredient is a sweetener selected from the group consisting of sucrose, glucose, multitol, xylitol, sorbitol and mannitol and mixtures thereof.

20           33. A chewing gum product in accordance with claim 28 which contains between about 0.5-25 weight percent of an alkali metal bicarbonate powder ingredient.



34. A chewing gum product in accordance with claim 28 which contains between about 0.001-0.2 weight percent of a colorant ingredient.

5 35. A chewing gum product in accordance with claim 28 which contains between about 1-20 weight percent of an abrasive ingredient.

36. A chewing gum product in accordance with claim 28 which contains between about 0.001-3 weight percent of a surfactant ingredient.

10 37. A chewing gum product in accordance with claim 28 which contains between about 0.05-3 weight percent of a fluoridating ingredient.

38. A chewing gum product in accordance with claim 28 which contains between about 15 0.1-15 weight percent of glycerin or lecithin or a mixture thereof.

39. A chewing gum product comprising between about 15-80 weight percent of a gum base, between about 5-70 weight percent of a water-soluble 20 bulking ingredient, and between about 1-30 weight percent of dispersed particles of an organic-

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- encapsulated alkali metal bicarbonate ingredient;  
wherein the encapsulated particles comprise an  
alkali metal bicarbonate crystallite core matrix  
having a surface-coating of an encapsulant  
5 comprising a blend of a film-forming organic  
ingredient and between about 0.1-25 weight percent  
of a flavorant ingredient, based on the encapsulant  
weight.

40. A chewing gum product in accordance  
10 with claim 39 wherein the bulking ingredient is a  
sweetener selected from the group consisting of  
sucrose, glucose, multitol, xylitol, sorbitol and  
mannitol and mixtures thereof.

41. A chewing gum product in accordance  
15 with claim 39 wherein the encapsulated flavorant is  
an ingredient selected from the group consisting of  
menthol, peppermint oil, spearmint oil, wintergreen  
oil, cinnamon oil and anise and mixtures thereof.

42. A method of oral hygiene which  
20 comprises orally masticating a claim 1 chewing gum  
product in accordance with a regimen which satisfies  
personal need and convenience.

43. A method of oral hygiene which comprises orally masticating a claim 39 chewing gum product in accordance with a regimen which satisfies personal need and convenience.

5           44. An encapsulated bicarbonate powder composition comprising particles which are comprised of an alkali metal bicarbonate crystallite core matrix having between about 0.1-25 weight percent of a flavorant ingredient adsorbed on the crystallite  
10 surface, based on the core matrix weight, and the core matrix of crystallite and adsorbed flavorant is surface-coated with a film-forming organic encapsulant.

          45. A bicarbonate powder composition in  
15 accordance with claim 44 wherein the organic encapsulant comprises between about 5-60 weight percent of the surface-coated bicarbonate particle dry weight.

          46. A bicarbonate powder composition in  
20 accordance with claim 44 wherein the organic encapsulant on the surface-coated bicarbonate particles is a hydrophilic polymer or water-insoluble polymer or a mixture thereof.

47. A bicarbonate powder composition in accordance with claim 44 wherein the flavorant is an ingredient selected from the group consisting of menthol, peppermint oil, spearmint oil, wintergreen  
5 oil, cinnamon oil and anise and mixtures thereof.

48. An encapsulated bicarbonate powder composition comprising particles which are comprised of an alkali metal bicarbonate crystallite core matrix having a surface-coating of an encapsulant  
10 comprising a blend of a film-forming organic ingredient and between about 0.1-25 weight percent of a flavorant ingredient, based on the encapsulant weight.

49. A bicarbonate powder composition in  
15 accordance with claim 48 wherein the organic encapsulant comprises between about 5-60 weight percent of the surface-coated particle dry weight.

50. A bicarbonate powder composition in accordance with claim 48 wherein the organic  
20 encapsulant on the surface-coated bicarbonate particles is a hydrophilic polymer or water-insoluble polymer or a mixture thereof.

51. A bicarbonate powder composition in  
accordance with claim 48 wherein the flavorant is an  
ingredient selected from the group consisting of  
menthol, peppermint oil, spearmint oil, wintergreen  
5 oil, cinnamon oil and anise and mixtures thereof.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/17088

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : A23G 3/30; A23L 1/221

US CL : 424/48; 426/5, 97, 99, 650, 651

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/48; 426/3, 4, 5, 6, 96, 97, 99, 650, 651

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
NONE**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1,991,726 A (BOSER) 19 February 1935 (19.02.35), See entire document.	
A	US 4,170,633 A (WAGENKNECHT ET AL) 09 October 1979 (09.10.79), See entire document.	
A	US 4,269,860 A (OGAWA ET AL) 26 May 1981 (26.05.81), See entire document.	
A	US 4,639,368 A (NIAZI ET AL) 27 January 1987 (27.01.87), See entire document.	
A	US 4,867,989 A (SILVA ET AL) 19 September 1989 (19.09.89), See entire document.	
A	US 5,087,461 A (LEVINE ET AL) 11 February 1992 (11.02.92), See entire document.	

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

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# INTERNATIONAL SEARCH REPORT

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PCT/US96/17088

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,433,960 A (MEYERS) 18 July 1995 (18.07.95), See entire document.	